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Two new species of *Neoperla* (Plecoptera, Perlidae) from Dabie Mountains of China

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Abstract

Two new species of the stonefly genus *Neoperla*, *N. nigromarginata* **sp. n.** and *N. similiflavescens* **sp. n.**, are described from Dabie Mountains of Central China in the Liankangshan National Nature Reserve. The new species are compared with related congeners.

Keywords

Plecoptera, Perlidae, Neoperla nigromarginata, Neoperla similiflavescens, new species, China

Introduction

Neoperla is the most species-rich stonefly genus in the family Perlidae in China (Du et al. 1999, Sivec et al. 1988, DeWalt et al. 2014). To date, seventy-seven *Neoperla* species from China have been reported and the systematic study of this genus in China includes contributions from Chu (1929), Du (1999, 2000a, 2000b), Du (1998), Du and Sivec (2004, 2005), Du and Wang (2005, 2007), Du et al. (1999, 2001), Kong Li et al. (2014), Li et al. (2011a), Li et al. (2011b), Li and Wang (2011), Li et al. (2012a), Li et al. (2012b), Li and Li (2013a, b), Li et al. (2013a), Li et al. (2013b), Li et al. (2014a), Li et al. (2014b), Qin et al. (2013), Sivec and Zwick (1987), Wang et al. (2013a), Wang et al. (2013b), Wu (1935, 1938, 1948, 1962, 1973), Wu and Claassen (1934), Yang and Yang (1990, 1991), and Yang and Yang (1992, 1993, 1995a, 1995b, 1996, 1998).

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In the present paper, two new species of *Neoperla*, *N. nigromarginata* sp. n. and *N. similiflavescens* sp. n., are described from Liankangshan National Nature Reserve of China, based on the specimens collected in the recent two years. The Reserve is located in the northern escarpment of Dabie Mountains, the border of Henan and Hubei provinces of Central China. The Reserve also includes the watershed of Yangtze River-Huaihe River basins and the northernmost boundary of subtropical zone (Ye et al. 2002).

Material and methods

The specimens used in this study were collected by light trap. Types and other examined material are deposited in the Insect Collection of Henan Institute of Science and Technology (HIST), Xinxiang, and the Entomological Museum of China Agricultural University (CAU), Beijing. They were examined with the aid of a Motic SMZ 168 microscope and the color illustrations were captured using digitalized Motic Images Advanced 3.2 software. All specimens were kept in 80% ethanol. Aedeagi were everted using the cold maceration technique of Zwick (1983). Terminology follows that of Sivec et al. (1988). All the scale lines in the figures represent 1.0 mm.

Results

Neoperla nigromarginata Li & Zhang, sp. n.

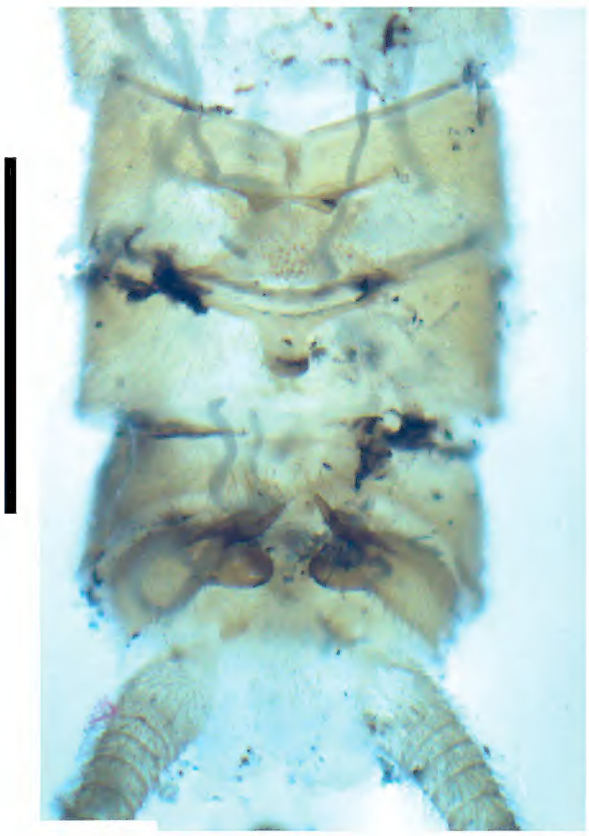
http://zoobank.org/14EAFB99-1450-4DF2-8ACF-E7FDB99620A3
Figs 1–2

Type material. Holotype. male (HIST), China: Henan Province, Xinyang City, Xin County, Liankangshan National Nature Reserve, Laomiao Protection station, 31°64,39'N, 114°87,95'E, light trap, 17 June 2014, W.H. Li. Paratypes: 4 females (2 in CAU), the same locality and data as holotype.

Adult habitus. Distance between ocelli slightly wider than diameter of the ocellus. Head pale yellow to brownish with black areas, slightly wider than pronotum, with a black rectangular area covering ocelli, a large black anterior spot and two small lateral spots present on frons (Fig. 1a); compound eyes black, antennae dark brown except several basal segments which are brown; maxillary palpi dark brown. Pronotum with black median areas of rugosities and lateral margins around the kidney shaped pale disc area (Fig. 1a); wings subhyaline, veins dark brown; legs dark brown with femora and inner part of tibia brownish to brown (Fig. 1e). Cerci dark brown, basal segments brown.

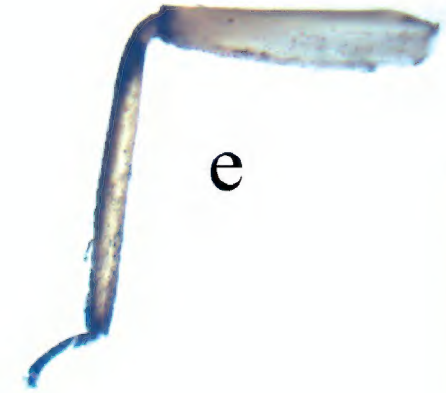
Male. Forewing length 11.8 mm. Tergum 7 with an anteromedian pair of sclerotized, upraised, nipple-shaped processes and a distal subquadrate process on posterior margin, covered with small sensilla basiconica (Fig. 1b). Tergum 8 with a recurved tongue shaped process, fringed with small spines at its distal margin (Figs 1b). Ter-

a



b

c



e

f

d

Figure 1. *Neoperla nigromarginata* Li & Zhang, sp. n. Male (**a–e**) **a** Head and pronotum, dorsal view **b** Terminalia, dorsal view **c** Terminalia, lateral view **d** Aedeagus before eversion, lateral view **e** Hindleg **f** Female subgenital plate, ventral view.

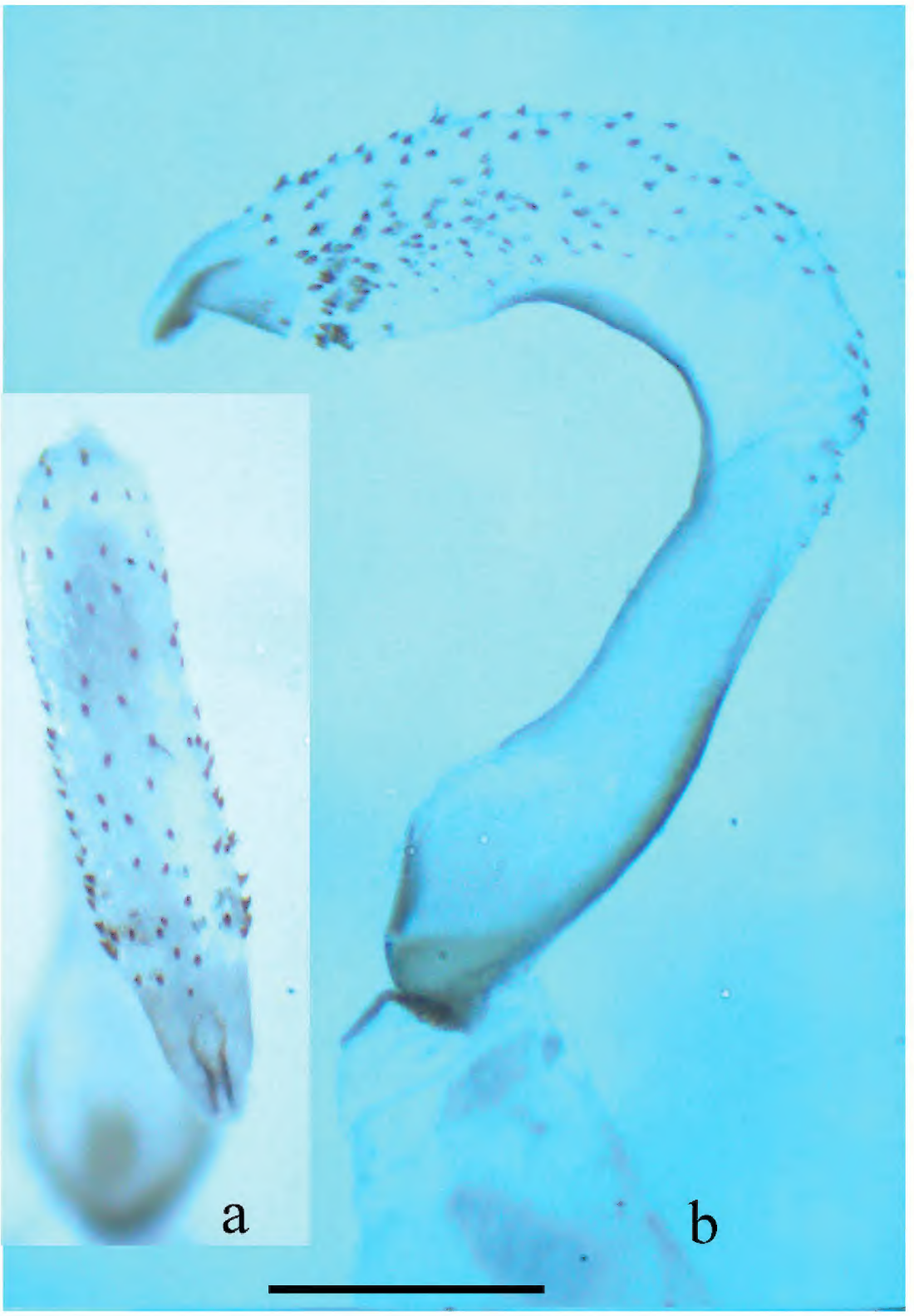


Figure 2. *Neoperla nigromarginata* Li & Zhang, sp. n. Male. **a** Dorsal aspect of aedeagal sac, top view **b** Aedeagus, lateral view. Note that the spines in **b** appear lightly pigmented and unclear, actually they are located on the lower surface of the sac, and are seen from beneath through the cuticle.

gum 9 without patches of sensilla basiconica. Hemitergal processes of tergum 10 with a swollen wide base medially curved with sharp tip (Fig. 1b). Aedeagal tube nearly straight, with basoventral and dorsal sclerites. Aedeagal sac membranous but basal half heavily sclerotized ventrally (Figs 1d, 2b). Sac about as long as tube and curved ventrally forming a right angle to tube, dorsal surface with 2-3 irregular rows of numerous small spines (Fig. 2a); lateral surface of sac with a large patch of numerous small spines at subapcial region (Fig. 2b); a pair of flagella present more evident in uneverted sac apex in dorsal view (Fig. 2a).

Female. Forewing length 13.4–14.0 mm. General color pattern similar to male. Sternum 7 slightly sclerotized except the posterior margin slightly produced forming sclerotized subgenital plate. Subgenital plate a small dark brown tab with slightly emarginate tip (Fig. 1f). Sternum 8 moderately sclerotized medially, posterior margin slightly produced in a narrow wide lobe.

Etymology. The specific epithet refers to the dark lateral margins of pronotum.

Distribution. China (Henan Province).

Diagnosis and remarks. The new species is a typical member of the *Neoperla montivaga* species group as defined by Zwick (1983). The new species has similar head pattern, terminalia and paired apical flagella of the aedeagal sac with *N. flagellata* Li & Murányi, 2012 and *N. tuberculata* Wu, 1937 (Figs 1–4, 7 in Li et al. 2012, Figs 5 and 10 in Li et al. 2013). However, *N. nigromarginata* is easily distinguishable from the latter two species by the distinctively pigmented pronotal lateral margins, short aedeagal sac (nearly as long as tube) with only dorsal spine patch at base and absence of a sac loop (Figs 1a, 2). In *N. flagellata* and *N. tuberculata*, both have long aedeagal sac (at least 1.5× as long as tube) forming a loop with lateral spine patches at base of aedeagal sac (Figs 5-9 in Li et al. 2012b, Figs 5 & 11 in Li et al. 2013a).

***Neoperla similiflavescens* Li & Zhang, sp. n.**

http://zoobank.org/5071BF60-1E10-4ABF-A529-7D88DC4A71D3

Figs 3–4

Type material. Holotype. male (HIST), China: Henan Province, Xinyang City, Xin County, Liankangshan National Nature Reserve, Laomiao Protection station, 31°64,39'N, 114°87,95'E, light trap, 15 June 2014, W.H. Li.

Male. Forewing length 13.9 mm. Distance between ocelli barely as wide as diameter of the ocellus. Head slightly wider than pronotum, mostly yellow brown, lateral margins and occiput behind compound eyes pale, a triangular dark area covering ocelli, a dark spot in front of M-line and U-shaped brownish spot between M-line and ocellus, M-line pale; antennae brown to dark brown, scape darker; compound eyes black; mouthparts brown (Fig. 3a). Pronotum brownish with wide darker median stripe and scattered markings of rugosities, legs brown; wings pale brown with dark vein. Abdomen brownish.

Terminalia. Tergum 7 with trapezoidal median process at posterior margin, covered by numerous tiny sensilla basiconica, anterior and lateral margins forming elevated plateau but with posteromedian concativity in which process of tergum 8 lies. Sclerotized process of tergum 8 recurved backward and triangular in shape. Tergum 9 with two submedial patches of long hairs. Hemitergal processes of tergum 10 strongly sclerotized and straight (Figs 3b and c). Aedeagus heavily sclerotized, subapical ventral projection triangular in lateral view and gradually tapering to a triangular tip (Figs 3d, 4a and b).

Female. Unknown.

Etymology. The specific epithet refers to the similarity to *Neoperla flavescens* Chu, 1929.

Distribution. China (Henan Province).

a

b

c

d

Figure 3. *Neoperla similiflavescens* Li & Zhang, sp. n. Male. **a** Head and pronotum, dorsal view **b** Terminalia, dorsal view **c** Terminalia, lateral view **d** Aedeagus, lateral view.

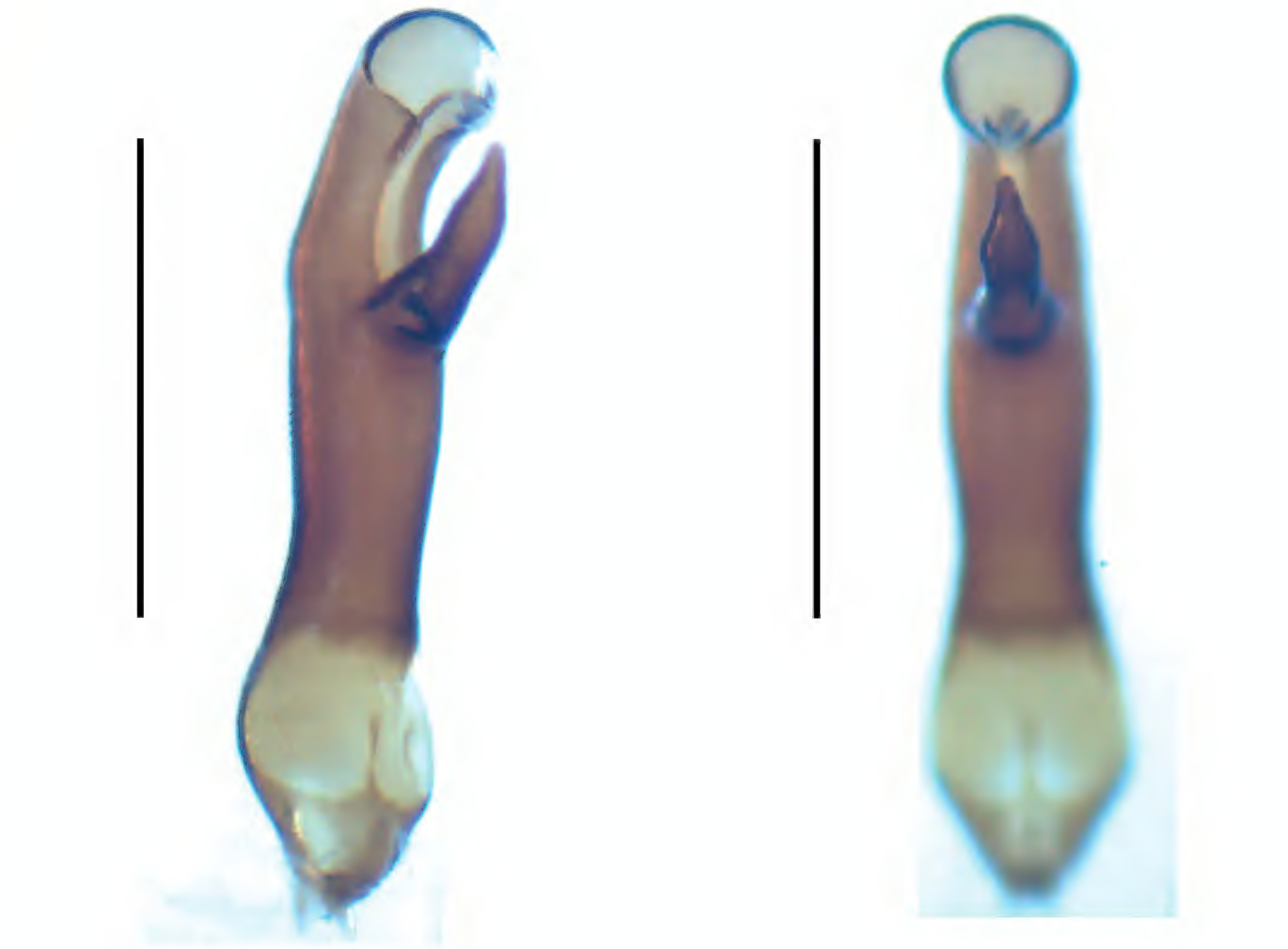


Figure 4. a–b *Neoperla similiflavescens* Li & Zhang, sp. n. Male. **c–d** *Neoperla flavescens* Chu. Male. **a** Aedeagus, oblique ventral view **b** Aedeagus, ventral view **c** Head and pronotum, dorsal view **d** Aedeagus, lateral view. *Neoperla flavescens* Chu for comparison. 1 male from Henan Province, Luoyang City, Song County, Cecun town, Muzhaling, 2012.VIII.19, Weihai Li.

Diagnosis and remarks. The new species may be assigned to the *Neoperla montivaga* species group as defined by Zwick (1983), because of the incomplete sclerotization of the aedeagal tube in ventral aspect (Fig. 4a). The new species seems closely related to *Neoperla flavescens* Chu originally known from Zhejiang Province, and recently also found from several provinces (Henan, Fujian and Shanxi) of China (Li et al. 2011a, Li et al. 2014). They are similar in general features of male terminalia and the aedeagal tube. However, the new species can be easily separated from *N. flavescens* Chu by the shape of ventral projection of aedeagal tube. The projection in *N. similiflavescens* is generally triangular in lateral view and tapers to a triangular tip (Fig. 3d) whereas it is generally finger-like and abruptly constricted subapically in a nipple-like tip in *N. flavescens* (Figs 4d & 5 in Li et al. 2011a). Their general body color and head pattern also differ to some degree: *N. similiflavescens* is generally brownish in color and spots on frons are well defined and small (Fig. 3a) while in *N. flavescens*, the general body color is brown and darker, the spots on frons are larger and obscure (Fig. 4c, Fig. 1 in Li et al. 2011a, Fig. 1a in Li et al. 2014a).

Concluding remarks

The present study is based on the insect collection of two years surveys to the Liankangshan National Nature Reserve organized by administrative bureau of the Reserve. In the year 2013 only several stonefly nymphs were collected before the present *Neoperla* finding. Previous study on the stoneflies from the Dabie Mountains only includes the description of *Neoperla jigongshana* Li & Li, 2014 (Li et al. 2014b) from Mountain Jigongshan, about 100 km far from the Reserve. However, there was no record of any group of stoneflies in previous studies on the insect fauna of the Liankangshan Nature Reserve. In this study, two additional new species are described and up to 3 *Neoperla* species are known from the Dabie Mountains presently.

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